LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Flow of Thin Liquid Films.

WHILST observing the "Brownian" movement of particles of gamboge in water with the aid of a microscope (magnification, about 360 diams.), it occurred to me to press gently on the cover-glass of the slide, so as to cause a movement of the water containing the suspended matter, and to note the paths of these in the vicinity of some larger stationary masses, as one would then be approaching the condition set forth by the late Sir G. G. Stokes, namely, that liquids in thin films behave as frictionless fluids. The results fully confirmed the behaviour of such thin films of liquid. The moving particles, as they rushed by the stationary masses, showed no trace of eddy currents, passing along the edges of the obstacle and leaving it without any swirls, as shown in Fig. 1. The moving particles next to the obstacle had a high velocity, and were in greater numbers per unit area, than those further removed; the obstacle had no effect upon distantly removed portions of the liquid—they moved in straight lines. For very low velocities the course of the particles was exceedingly in accordance with the motion of a frictionless fluid. With high velocities, a cone of slow-moving liquid formed both in front and behind the obstacle, as shown in Fig. 2. When two masses are in the same line of flow, it is difficult to prevent a certain number of particles, mapping out a stream-line, from crossing over from one side to the other between the obstacles, as shown in Fig. 3. We have here a hydrodynamical analogy to the circuit of a Wheatstone bridge when determining the value of an unknown resistance. The liquid represents the metallic circuit, the particles of gamboge the current—or the corpuscles if preferred, the two obstacles the insulation between R_1, R_2 and R_3, R_4, and the fluid between them the galvanometer circuit.

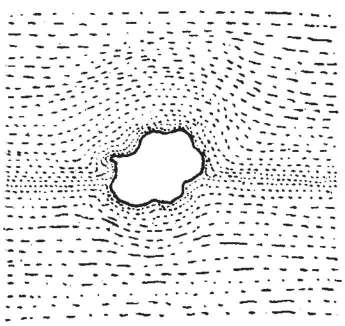

FIG. 1.

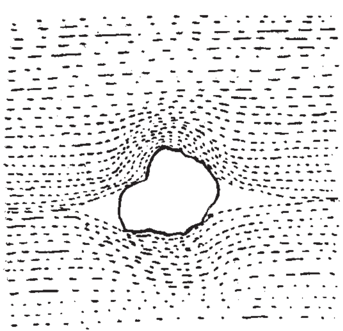

FIG. 2.

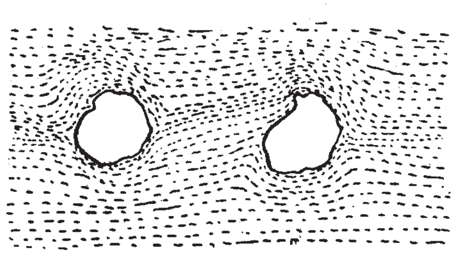

FIG. 3.

When equilibrium is established, no current flows through the galvanometer: no fluid passes across the intervening space between the two obstacles. Vary any one of the resistances, and equilibrium is upset, causing a current to flow through the galvanometer; cause an unbalanced pressure on one side or the other of the line joining the two obstacles, and a current of fluid flows from the place of greater to that of lesser pressure.

Very interesting effects are produced by introducing air bubbles into the liquid instead of solid obstacles. On pressing the cover-glass, the bubble appears to increase in size, while at the same time a rush of liquid passing it is noticed; on releasing the pressure, the bubble contracts, the liquid moving in the opposite direction. One of the most striking effects is seen when a bubble moves of its own accord through the liquid. The effect is difficult to produce, but well repays the effort. As before, gamboge is used to define the course of the surrounding fluid. As the bubble moves forward, the fluid next it is seen to be moving along its edge in the *same direction*, while at a little distance it is moving in the opposite direction to that in which the sphere moves. This effect is shown by the arrows in Fig. 4, the heavy arrow denoting the direction in which the sphere is moving. At the pole *c* the fluid seems to appear, passes with a high velocity to the pole *d via* the surface of the bubble, and disappears. The effect of the moving bubble on the surrounding liquid extends for a great distance compared with the case when the liquid is in motion and the obstacle stationary (*vide ante*).

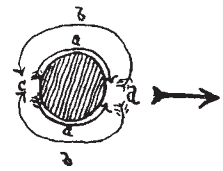

FIG. 4.

W. G. ROYAL-DAWSON.

4 Montague Street, London, W.C., March 6.

Water-Vapour on Mars.

I NOTE in NATURE of February 9 (p. 486) an account of a recent unsuccessful attempt to verify the existence of water-vapour on Mars, already demonstrated by means of other methods by Dr. Slipher and myself (see *The Astrophysical Journal*, vol. xxviii., p. 397, December, 1908, and Lowell Observatory Bulletins, Nos. 36, 43, and 49). Will you allow me to point out that the method employed by Director Campbell was proposed several years ago by Dr. Percival Lowell, and was actually tested by Dr. Slipher at the Lowell Observatory in 1905, with a result similar to that which Director Campbell has now obtained in his repetition of the experiment? The details may be found in Lowell Observatory Bulletin No. 17.

The reason for the failure perhaps lies in the insensitiveness of the method. The spectrum of a body no brighter than Mars cannot be obtained with the utmost fineness of detail under a high dispersion, because a relatively wide slit has to be used, or else a very long exposure must be given to the photographic plate, either of which is fatal to sharp definition of fine spectral lines. In these circumstances it is not easy to distinguish between the terrestrial and planetary components of a fine absorption line with the high dispersion which is absolutely necessary to the success of the experiment.

It still seems to me that the best method of measuring the Martian aqueous vapour which is at present available consists in the observation of the little *a* band with a spectrograph of low dispersion, which gives the band as a shading in which individual lines cannot be discriminated, but the integrated intensity of which can be measured photometrically. The method is also applicable to those diffuse bands discovered by Abney and Festing in nearly saturated aqueous vapour, which apparently are not composed of fine lines, but which are sometimes much more intense than the linear groups.

FRANK W. VERY.

Astrophysical Observatory, Westwood,
Massachusetts, March 6.

The Fox and the Fleas.

I HAVE just been told a very interesting story by Mr. James Day of this town. Many years ago he and his father, both then engaged in agriculture, were sitting with their backs to the straw-covered hurdles which had

been put up to protect some sheep and lambs from the wind, when they noticed a fox come searching along the hedgerows. They kept perfectly still and watched, and, when he got nearer, they saw that he was collecting the sheep's wool caught on the thorns and brambles. When he had gathered a large bunch he went down to a pool at the junction of two streams, and, turning round, backed slowly brush first into the water, until he was all submerged except his nose and the bunch of wool, which he held in his mouth. He remained thus for a short time, and then let go of the wool, which floated away; then he came out, shook himself, and ran off.

Much astonished at this strange proceeding, they took a shepherd's crook, went down to the water's edge, and pulled the wool out. They found that it was full of fleas, which, to save themselves from drowning, had crept up and up the fox's brush and body and head and into the wool, and that thus the wily fox had got rid of them.

Cambridge, March 20. T. McKENNY HUGHES.

THE CIRCULATION OF AIR IN THE SOUTHERN HEMISPHERE.[1]

IN this investigation of the circulation of the atmosphere in the southern hemisphere, the author has taken a new course. Instead of proceeding in the usual way from tables of wind-direction and force, he has taken as the groundwork of his researches the atmospheric whirls themselves. He does not deal with cyclonic systems, as one might at first suppose, but with the anticyclonic, the travelling high-pressure systems. The reason of this is plainly due to his previous work, "A Discussion of Australian Meteorology" (London, 1909). After a four-year period in the variations of air-pressure over India, South Africa, and South America, and their relations to the four-year cycle in the solar variations had been successfully demonstrated, it was necessary to investigate the weather conditions in Australia with that object. In the subtropical continents of the southern hemisphere weather conditions are chiefly influenced by barometric maxima almost constantly travelling from west to east. This was first shown to be so for Australia by the astronomer H. C. Russell, of Sydney, to whom the meteorology of that continent is so much indebted.

Russell already held the opinion that these travelling barometric maxima (with the V-shaped depressions accompanying them on their south side) do not originate on the continent itself, but approach from the South Indian Ocean. In Dr. Lockyer's extensive work, above quoted, it was shown more conclusively that in the Australian area, in latitudes 20° to 40° S., anticyclonic systems travel with great velocity from west to east, and that this also holds good for South America, South Africa, and Mauritius, in the same belt of latitude. In all probability, what holds good for 130° of longitude would also obtain for the rest of the earth's circumference. A proof of this would be of great importance for the weather prediction of these southern continents. The inquiry was therefore extended over the whole southern hemisphere, in order to obtain at the same time a more secure basis for the determination of the effects of the solar variations on the circulation of the air of the southern hemisphere.

The collection of the materials for this widely extended investigation naturally gave the author much trouble and difficulty. The determination of the amplitudes of the waves of atmospheric pressure over the whole of the district in question formed the preliminary part of the work in view. The author rightly confined himself to the southern winter half-year (April to September). It is quite clear that in calculating the mean height of the pressure waves, all waves, including even the smallest, cannot be taken into account, but only those of a certain magnitude. The author finds the amplitude of the pressure wave (Schwellenwerth) for these by selecting the three greatest wave heights for each station and takes one-fifth of the mean as the lower limit. This value (Schwellenwerth) is naturally different for different places in the various latitudes.

Dr. Lockyer calculates in this way the mean heights of the waves of air-pressure for fifty-five places in the southern hemisphere, between the equator and the Antarctic continent, and enters the values in the chart. That leads further to the drawing of lines of equal wave heights of oscillations of air-pressure. The author denotes these lines by the somewhat mysteriously sounding Greek compound "Isanakatabars": lines of equal up and down movements of air-pressure. The mean amplitudes of the waves of air-pressure naturally increase from the tropics towards higher latitudes. In latitude 0° to 12° S. they reach 1 to 2 mm.; from 12° S. they increase very rapidly and attain a maximum of 18 to 19 mm. in 53° to 60° S., and then decrease again to 14 to 15 mm. in South Victoria Land. The Isanakatabar of 16 mm. occasionally fringes the Antarctic continent. The increase of the wave heights towards the south is explained by the fact that from the belt of the travelling barometric maxima, with still relatively small amplitudes, we first enter the region of V-shaped depressions which accompany them, and then, finally, that of the large cyclones of higher latitudes, the mean tracks of which may probably be taken as between 55° and 60° S. At the southern limit of these, towards the permanent Antarctic anticyclone, the amplitudes again decrease. But, generally speaking, the Isanakatabars run fairly parallel to the parallels of latitude. They exhibit, however, the peculiarity that on the mountain ranges of the west sides of South Africa and South America they trend downwards in higher latitudes, but leave the east coasts in lower latitudes. This may be ascribed to the westerly ranges of mountains in these continents.

These Isanakatabars form the starting point of further very interesting deductions by the author.

It may here be remarked that Kämtz, in his "Lehrbuch der Meteorologie" (vol. ii., p. 339), has endeavoured to draw lines of equal non-periodical oscillations of air-pressure. He calculated for numerous stations of the northern hemisphere the mean value of the *monthly variation* of air-pressure, and called his lines based thereon somewhat improperly "isobarometric" lines. It is certainly noteworthy that lines of equal barometric variation were drawn (1832) long before it was thought of constructing lines of equal air-pressure (isobars). These were first drawn by Renou (1864), and then particularly by Buchan (1869). Kämtz also remarked that his lines did not run wholly with the parallels of latitude, but that, *e.g.* the line of 8 par. lines = 18 mm., is met with on the east coast of the United States in 36° N. latitude, but in western Europe in 42°. At a much later period Fehlberg and Köppen again investigated the variations of air-pressure on a much broader basis, but also for the interval of a month (*Aus dem Archiv d. Deutschen Seewarte*, 1878, and *Meteorologische Zeitschrift*, 1883). These *monthly* barometer variations are naturally a much rougher measure of the irregular variations of pressure than the mean height of the individual pressure waves calculated by Dr. Lockyer. Köppen has already remarked that the lines of equal variations of air-pressure should be in relation with the direction of the tracks of the barometer minima.

[1] Solar Physics Committee. Southern Hemisphere Surface-air Circulation: Being a Study of the Mean Monthly Pressure Amplitudes, the Tracks of the Anticyclones and Cyclones, and the Meteorological Records of several Antarctic Expeditions. By Dr. W. J. S. Lockyer, under the direction of Sir Norman Lockyer, K.C.B., F.R.S. Pp. ix+111+xv plates. (London: H.M.S.O., Wyman and Sons, Ltd. Edinburgh: Oliver and Boyd. Dublin: E. Ponsonby, Ltd., 1910.) Price 6*s*.